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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:
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Serial No.: 09/851,900

Filed: May 9, 2001

For: METHOD AND APPARATUS FOR CONTROLLING FOCUS BASED ON A THICKNESS OF A LAYER OF PHOTORESIST

Examiner: C. Young

Group Art Unit: 1756

Att'y Docket: 2000.042200

APPEAL BRIEF

CERTIFICATE OF MAILING
37 C.F.R. 1.8

I hereby certify that this correspondence is being sent by U.S. Mail, First Class, to: Assistant Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on the date below:

October 7, 2003 Kathryn Mayer
Date Signature

BOX AF
Commissioner of Patents
P.O. Box 1450
Arlington, VA 22313-1450

Sir:

Applicant hereby submits an original and two copies of the Appeal Brief to the Board of Patent Appeals and Interferences in response to the final Office Action dated June 11, 2003 and the Notice of Appeal dated July 8, 2003. **The Assistant Commissioner is authorized to deduct the fee for filing this Appeal Brief ($330.00) from Advanced Micro Devices, Inc. Deposit Account No. 01-0365/TT3165.** In the event the monies in that account are insufficient, the Assistant Commissioner is authorized to withdraw funds from Williams, Morgan & Amerson, P.C. Deposit Account No. 50-0786/2000.042200.

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01 FC:1402 220.00 DA 110.00 OP

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As the two-month date to file the Appeal Brief following filing the Notice of Appeal expired September 8, 2003, Appellants hereby request a one-month extension of time, up to and including October 8, 2003, to file the Appeal Brief. A check in the amount of $110.00 is enclosed. Said check represents cost for the one-month extension. However, if the check is inadvertently omitted, the Assistant Commissioner is hereby authorized to withdraw funds from Williams, Morgan & Amerson, P.C. Deposit Account No. 50-0786/2000.042200.

I. REAL PARTY IN INTEREST

The present application is owned by Advanced Micro Devices, Inc. The assignment of the present application to Advanced Micro Devices, Inc., is recorded at Reel 011807, Frame 0521.

II. RELATED APPEALS AND INTERFERENCES

Applicant is not aware of any related appeals and/or interferences that might affect the outcome of this proceeding.

III. STATUS OF THE CLAIMS

Claims 1-11 are pending in the application. The claims as currently pending are attached as Appendix A. Claims 1-11 stand rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Adams (U.S. Patent No. 5,362,585).

IV. STATUS OF AMENDMENTS

There were no amendments after the final rejections.

V. SUMMARY OF THE INVENTION

Photolithography is commonly used to pattern processing layers in semiconductor devices. In general, a photolithography process involves forming a layer of photoresist above a previously formed process layer and exposing selected portions of the layer of photoresist to a light source. The light interacts with the photoresist to form a pattern in the photoresist layer. Thereafter, an etching process, such as a plasma etching process, is performed to transfer the photoresist pattern to the underlying process layer. For example, the plasma etching process may remove portions of the underlying process layer that are not covered, or masked, by the patterned photoresist layer.

A typical layer of photoresist may have a thickness varying from approximately 1500-15,000 Å. Although the thickness of the photoresist is usually required to have a uniformity of ±100 Å, even this permissible variation may have undesirable effects. For example, when the photoresist is exposed to the light source, the light is generally focused at a preselected location above the substrate, which during ideal operating conditions coincides with the top surface of the layer of photoresist. However, when the photoresist is thicker or thinner than desired or anticipated, then the focal plane of the light source falls below or above the surface of the photoresist, respectively. Accordingly, the patterns or features formed in the layer of photoresist may not be as precise as desired. As a result, the features formed in the underlying process layer after the etching process is performed may also not be as precise as required or desired.

Moreover, variations in the thickness of process layers underlying the layer of photoresist may also cause a position of the top surface of the photoresist layer to vary such that it does not coincide with the focal plane of the light source. Thus, the light source may be slightly out of focus, which may reduce the precision with which the pattern may be formed in the photoresist layer. Reduced precision in forming the pattern in the photoresist may cause variations in the size or configuration of various features of the semiconductor device. The feature variations may result in the semiconductor device having a variety of undesirable characteristics, such as increased leakage currents, increased capacitance, and the like. In the worst case, the feature variations may render the semiconductor device inoperable.

Thus, with regard to independent claim 1, Appellants describe and claim forming a layer of photoresist above a process layer formed above a first semiconducting substrate and determining a position of a top surface of the layer of photoresist. Appellants further describe and claim positioning a focal plane of a light source adjacent the layer of photoresist based upon the determined position of the top surface and energizing the light source. For example, the determined position of the top surface of the layer of photoresist may be provided to a controller and used to properly position a wafer within a stepper. Consequently, the position of the wafer relative to the light source is controlled to locate the focal plane of the light source in a region generally coinciding with a top surface of the layer of photoresist.

In one embodiment of the present invention, such as that set forth in claims 2-5 and 8-11, the position of the top surface of the photoresist layer may be determined by sensing a thickness

of the photoresist layer. In addition, in various alternative embodiments, a thickness of an underlying layer, as set forth in claims 8-9, and/or a thickness of a substrate, as set forth in claims 10-11, may be determined. For example, the thickness of the photoresist layer, the underlying layer, and/or the substrate may be sensed using a metrology tool 38 capable of sensing or measuring such a thickness. See Patent Application, page 14, ll. 7-8 and Figure 2.

In the embodiments claimed in claims 2-5 and 8-11, the sensed thickness may be provided to a controller and used to properly position the wafer within the stepper. Consequently, the position of the wafer 10 relative to the light source is controlled to locate the focal plane of the light source in a region generally coinciding with a top surface 24 of the layer of photoresist 23. For example, if the determined thickness of the layer of photoresist 23 is less than desired, the wafer 10 may be moved in closer proximity to the light source so that the focal plane falls generally near the surface 24 of the layer of photoresist 23. Conversely, if the layer of photoresist 23 is thicker than desired, the wafer 10 may be moved further from the light source so that the focal plane falls generally near the surface 24 of the layer of photoresist 23. See Patent Application, page 9, ll. 1-15 and Figure 2.

VI. ISSUE ON APPEAL

Appellant respectfully requests that the Board review and overturn the single rejection present in this case. The following issue is presented on appeal in this case: whether claims 1-11 are obvious over Adams?

VII. GROUPING OF THE CLAIMS

For the issues presented above, claims 1 and 6-7 may be considered to stand or fall together, and claims 2-5 and 8-11 may be considered to stand or fall together.

VIII. ARGUMENT

A. Legal Standards

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, all the claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 U.S.P.Q. 580 (CCPA 1974). Second, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Third, there must be a reasonable expectation of success. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 U.S.P.Q.2d 1438 (Fed. Cir. 1991); M.P.E.P. § 2142. If an independent claim is nonobvious under 35 U.S.C. § 103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F.2d 1071, 5 U.S.P.Q.2d 1596 (Fed. Cir. 1988); M.P.E.P. § 2143.03.

With respect to alleged obviousness, there must be something in the prior art as a whole to suggest the desirability, and thus the obviousness, of making the combination. *Panduit Corp. v. Dennison Mfg. Co.*, 810 F.2d 1561 (Fed. Cir. 1986). In fact, the absence of a suggestion to combine is dispositive in an obviousness determination. *Gambro Lundia AB v. Baxter Health-*

care Corp., 110 F.3d 1573 (Fed. Cir. 1997). The mere fact that the prior art can be combined or modified does not make the resultant combination obvious unless the prior art also suggests the desirability of the combination. *In re Mills*, 916 F.2d 680, 16 U.S.P.Q.2d 1430 (Fed. Cir. 1990); M.P.E.P. § 2143.01. The consistent criterion for determining obviousness is whether the prior art would have suggested to one of ordinary skill in the art that the process should be carried out and would have a reasonable likelihood of success, viewed in the light of the prior art. Both the suggestion and the expectation of success must be founded in the prior art, not in the Applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 U.S.P.Q.2d 1438 (Fed. Cir. 1991; *In re O'Farrell*, 853 F.2d 894 (Fed. Cir. 1988); M.P.E.P. § 2142.

B. Claims 1-11 Are Not Obvious over Adams

As will be discussed in detail below, Appellants respectfully submit that the present invention is not obvious over Adams for many reasons. First, all the claim limitations are not taught, inherently or explicitly, by the prior art. Second, there is no suggestion or motivation, either in the cited reference or in the knowledge generally available to one of ordinary skill in the art, to modify the reference to arrive at Appellants' claimed invention.

Adams is directed to determining a machine focus to be used in forming a latent image in a layer of photosensitive resist material. In particular, Adams describes an apparatus 29 utilized to measure the intensity of light scattered from an interface between an exposed portion of photoresist 33 and an unexposed portion of photoresist 31. See Adams, col. 6, ll. 20-24. Adams describes determining a gradient of a photoactive compound using one or more measured intensities of the scattered light and then determining focus values based upon the determined gradient. See Adams, col. 9, ll. 20 - col. 10, ll. 42. For example, Adams describes determining a

"machine focus," by creating a plurality of subfield arrays 51 including individual feature clumps 61. The stepper focus is changed slightly by a known amount to create each of the feature clumps 61. See Adams, col. 7, ll. 13-20 and Figure 3.

The images in the feature clumps 61, such as the latent images 185, are interrogated using a beam and the maximum intensity of the fraction of the scattered light that reaches a detector 187 is measured. Additional feature groups 82 within the feature clump 61 are also interrogated and the maximum intensity of the fraction of the scattered light is measured for each feature group 82. Then, each of the values obtained for the signal strength, *i.e.* the maximum intensity, is least-squares-fitted against its corresponding focus and a maximal value of the signal strength is determined. The focus values corresponding to the maximal value, or an average of maximal values obtained for different feature groups 82 and/or clumps 61, may be chosen as the machine focus. See Adams, col. 9, ll. 25 - col. 10, ll. 41 and Figure 6.

However, as admitted by the Examiner at item 3 on page 3 of the Final Office Action mailed on April 29, 2003, Adams does not teach or suggest determining a position of a top surface of the layer of photoresist or positioning a focal plane of a light source adjacent the layer of photoresist based upon the determined position. Despite acknowledging this deficiency in Adams, the Examiner nevertheless alleges that the present invention is obvious over Adams. To support this allegation, the Examiner states that it is clear that many of the parameters determined within the metes and bounds of the reference clearly require determination of the surface of the photoresist. In particular, the Examiner alleges, without record support, that the focal plane and the location of the top surface of the photoresist layer may be determined by the

method described by Adams. Based upon the Examiner's statements regarding the obviousness rejection, Appellants are not clear whether the Examiner is alleging that the admittedly missing limitations are *inherently taught* by Adams or an *obvious variation* of Adams. However, Appellants respectfully submit that the present invention is neither *inherently taught* by Adams nor an *obvious variation* of Adams.

Appellants respectfully submit the present invention as claimed in independent claim 1 is not *inherently taught* by Adams. It is well established that inherency requires that the asserted proposition *necessarily* flow from the disclosure. It is not enough that a reference could have, should have, or would have been used as the claimed invention. "The mere fact that a certain thing may result from a given set of circumstances is not sufficient." *Oelrich*, at 326, quoting *Hansgirg v. Kemmer*, 40 U.S.P.Q. (BNA) 665, 667 (C.C.P.A. 1939); *In re Rijckaert*, 28 U.S.P.Q.2d (BNA) 1955, 1957 (Fed. Cir. 1993), quoting *Oelrich*, at 326; *see also Skinner*, at 1789. "Inherency... may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient." *Ex parte Skinner*, 2 U.S.P.Q.2d (BNA) 1788, 1789 (Bd. Pat. App. & Int. 1987), citing *In re Oelrich*, 666 F.2d 578, 581 (C.C.P.A. 1981).

As discussed above, Adams describes selecting a machine focus based upon the intensities of the light scattered from a plurality of feature groups 82 and/or clumps 61. The intensity of the scattered light may depend, in part, on the relative position of the focal plane and the top surface of the layer of photoresist. According to the Examiner, the machine focus selected according to the method described by Adams may, in some cases, *coincidentally*

correspond to the focal plane being adjacent the top surface of the photoresist layer. This contention is based upon mere supposition by the Examiner. The method described by Adams does not *necessarily* result in the focal plane being adjacent the top surface of the photoresist layer. Thus, Appellants respectfully submit that the Examiner's asserted proposition, *i.e.* that Adams inherently determines the position of a top surface of the layer of photoresist and positions a focal plane of a light source adjacent the layer of photoresist based upon the determined position, does not *necessarily* flow from the disclosure of Adams.

Moreover, the present invention as claimed in independent claim 1 is not an *obvious variation* of Adams, at least in part because the cited prior art does not teach or suggest all the claim limitations. As admitted by the Examiner, Adams does not teach or suggest determining a position of a top surface of the layer of photoresist. Furthermore, the machine focus described by Adams is determined based upon the intensities the light scattered from a plurality of feature groups 82 and/or clumps 61. Thus, Adams also fails to teach or suggest or positioning a focal plane of a light source adjacent the layer of photoresist based upon the determined position of the top surface of the layer of photoresist.

There is also no suggestion or motivation, either in Adams or in the knowledge generally available to one of ordinary skill in the art, to modify the reference to arrive at Appellants' claimed invention. Adams is directed to determining a gradient of a photoactive compound using one or more measured intensities of the scattered light and therefore provides no suggestion or motivation to modify Adams to arrive at Appellants' claimed invention. *i.e.* determining a position of a top surface of the layer of photoresist. Adams also teaches determining focus

values based upon the determined gradient of the photoactive compound and thus provides no suggestion or motivation for positioning a focal plane of a light source adjacent the layer of photoresist based upon the determined position of the top surface of the layer of photoresist.

With regard to dependent claims 2-5 and 8-11, Appellants further describe and claim, among other things, sensing a thickness of the layer of photoresist and positioning the focal plane of the light source adjacent said layer of photoresist based upon said determined thickness. In contrast, Adams is completely silent with regard to sensing a thickness of the layer of photoresist. Moreover, Adams is concerned with determining a gradient of a photoactive compound across a surface of the photoactive compound, and using one or more measured intensities of the scattered light and then determining focus values based upon the determined gradient. See Adams, Figures 4 and 5. Thus, Adams provides no suggestion or motivation for determining a thickness of the layer of photoresist. Consequently, Adams also provides no suggestion or motivation for positioning the focal plane of the light source adjacent said layer of photoresist based upon said determined thickness.

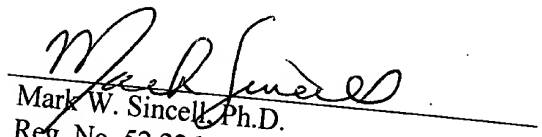
For at least the aforementioned reasons, Appellants respectfully submit that Adams does not teach, inherently or explicitly, all the limitations of claims 1 and 6-7. Appellants also respectfully submit that Adams does not teach, inherently or explicitly, the additional limitations set forth in dependent claims 2-5 and 8-11. Furthermore, there is no suggestion or motivation, either in the cited reference or in the knowledge generally available to one of ordinary skill in the art, to modify the reference to arrive at Appellants' claimed invention.

IX. CONCLUSION

In view of the foregoing, it is respectfully submitted that the Examiner erred in not allowing all claims pending in the present application, claims 1-11, over the prior art of record. The undersigned may be contacted at (713) 934-4052 with respect to any questions, comments or suggestions relating to this appeal.

Respectfully submitted,

Date: 10/7/03



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AGENT FOR APPLICANTS

APPENDIX A

1. A method, comprising:

forming a layer of photoresist above a process layer formed above a first semiconducting substrate;

determining a position of a top surface of said layer of photoresist;

positioning a focal plane of a light source adjacent said layer of photoresist based upon said determined position; and

energizing said light source.

2. The method of claim 1, wherein determining the position of the top surface of said layer of photoresist comprises sensing a thickness of the layer of photoresist and positioning the focal plane of the light source comprises positioning the focal plane of the light source adjacent said layer of photoresist based upon said determined thickness.

3. The method of claim 2, wherein sensing the thickness of the layer of photoresist comprises determining the thickness of the layer of photoresist at one or more spaced apart locations.

4. The method of claim 2, wherein sensing the thickness of the layer of photoresist comprises determining the thickness of the layer of photoresist at a plurality of locations and averaging the determined thicknesses.

5. The method of claim 2, wherein sensing the thickness of the layer of photoresist comprises determining the thickness of the layer of photoresist at a plurality of locations and

applying a least squares method to determine an approximate thicknesses of the layer of photoresist.

6. The method of claim 1, wherein positioning the focal plane of the light source adjacent said first layer of photoresist based upon said determined position comprises moving the semiconducting substrate to position the focal plane of the light source adjacent the first layer of photoresist.

7. The method of claim 1, wherein positioning the focal plane of the light source adjacent said first layer of photoresist based upon said determined position comprises moving the light source to position the focal plane of the light source adjacent the first layer of photoresist.

8. The method of claim 1, wherein determining the position of the top surface of said layer of photoresist comprises sensing a thickness of the layer of photoresist and an underlying layer, and positioning the focal plane of the light source comprises positioning the focal plane of the light source adjacent said layer of photoresist based upon said determined thickness of said layer of photoresist and the underlying layer.

9. The method of claim 8, wherein sensing the thickness of the layer of photoresist and the underlying layer comprises sensing the collective thickness of the layer of photoresist and the underlying layer.

10. The method of claim 1, wherein determining the position of the top surface of said layer of photoresist comprises sensing a thickness of the layer of photoresist, an underlying

layer, and a substrate, and positioning the focal plane of the light source comprises positioning the focal plane of the light source adjacent said layer of photoresist based upon said determined thickness of said layer of photoresist, the underlying layer, and the substrate.

11. The method of claim 10, wherein sensing the thickness of the layer of photoresist, the underlying layer, and the substrate comprises sensing the collective thickness of the layer of photoresist, the underlying layer, and the substrate.

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Faxes to the Office of Patent Publication

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